DAVID E. LEE
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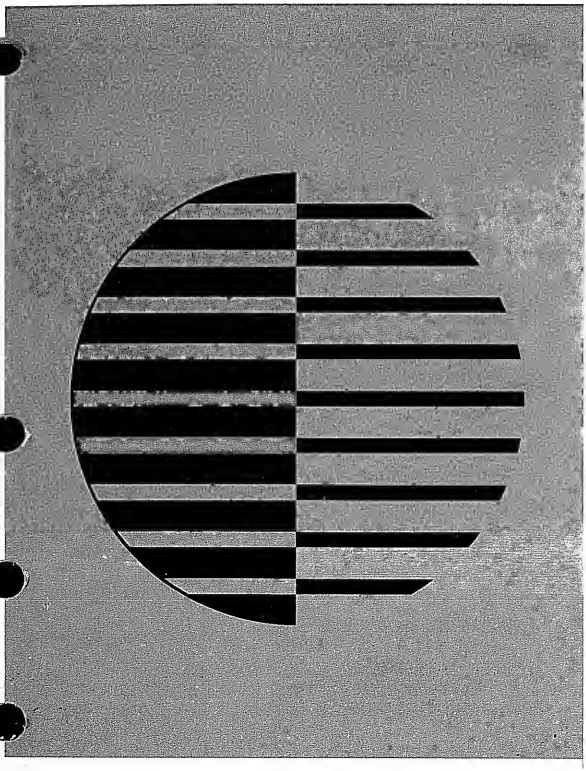
CODES/CONTROL DATA®
6400/6500/6600
Computer Systems



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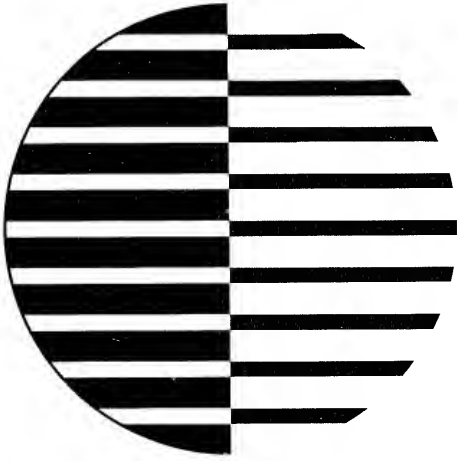

60141900	**Record of Revisions**
REVISION	NOTES
A	System Macros added. Obsoletes all previous editions.
(4-30-65)	
B	Publications Change Order 12374 extends the scope of
(2-7-66)	this manual from 6600 to 6400/6600. 415-B, 523, and
	544 Card Punches; 501-B Printer; and System Macros
	were deleted. This edition obsoletes all previous
	editions.
C	Publications Change Order 16533 extends the scope of
(6-15-67)	manual from 6400/6600 to 6400/6500/6600. 6638 Disk
	System is added. This edition obsoletes all previous
	editions.

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Address comments concerning this manual to:

Control Data Corporation
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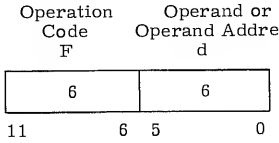
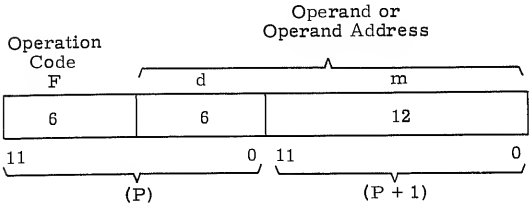
EXPLANATION OF PERIPHERAL AND CONTROL PROCESSOR INSTRUCTION FORMATS

An instruction may have a 12-bit or a 24-bit format. The 12-bit format has a 6-bit operation code F and a 6-bit operand or operand address d.



The 24-bit format uses the 12-bit quantity m, which is the contents of the next program address (P + 1), with d to form an 18-bit operand or operand address.



EXPLANATION OF SYMBOLS USED IN PERIPHERAL AND CONTROL PROCESSOR INSTRUCTION LISTINGS

d	Implies d itself
(d)	Implies the contents of d
((d))	Implies the contents of the location specified by d
m	Implies m itself used as an address
m + (d)	The contents of d are added to m to form an operand (jump address)
(m + (d))	The contents of d are added to m to form the address of the operand
dm	Implies an 18-bit quantity with d as the upper 6 bits and m as the lower 12 bits

PERIPHERAL AND CONTROL PROCESSOR INSTRUCTIONS

All times are given in major cycles

One major cycle = 1000 nanoseconds

1. NUMERICAL LISTING

F	MNE-MONIC	AD-DRESS	NAME	TIME (Major Cycles)
00	PSN		Pass	1
01	LJM	m d	Long jump to m + (d)	2-3
02	RJM	m d	Return jump to m + (d)	3-4
03	UJN	d	Unconditional jump d	1
04	ZJN	d	Zero jump d	1
05	NJN	d	Nonzero jump d	1
06	PJN	d	Plus jump d	1
07	MJN	d	Minus jump d	1
10	SHN	d	Shift d	1
11	LMN	d	Logical difference d	1
12	LPN	d	Logical product d	1
13	SCN	d	Selective clear d	1
14	LDN	d	Load d	1
15	LCN	d	Load complement d	1
16	ADN	d	Add d	1
17	SBN	d	Subtract d	1
20	LDC	dm	Load dm	2
21	ADC	dm	Add dm	2
22	LPC	dm	Logical product dm	2
23	LMC	dm	Logical difference dm	2
24	PSN		Pass	1
25	PSN		Pass	1
260	EXN		Exchange jump*	
261	MXN		Monitor exchange jump**	

*In 6500 System, Bit 0 specifies which CP the Exchange Jump will interrupt.

**Standard Option 10103 for 6400; Standard Option 10104 for 6600.

F	MNE-MONIC	AD-DRESS	NAME	TIME (Major Cycles)
27	RPN		Read program address	1
30	LDD	d	Load (d)	2
31	ADD	d	Add (d)	2
32	SBD	d	Subtract (d)	2
33	LMD	d	Logical difference (d)	2
34	STD	d	Store (d)	2
35	RAD	d	Replace add (d)	3
36	AOD	d	Replace add one (d)	3
37	SOD	d	Replace subtract one (d)	3
40	LDI	d	Load ((d))	3
41	ADI	d	Add ((d))	3
42	SBI	d	Subtract ((d))	3
43	LMI	d	Logical difference ((d))	3
44	STI	d	Store ((d))	3
45	RAI	d	Replace add ((d))	4
46	AOI	d	Replace add one ((d))	4
47	SOI	d	Replace subtract one ((d))	4
50	LDM	m d	Load (m + (d))	3-4
51	ADM	m d	Add (m + (d))	3-4
52	SBM	m d	Subtract (m + (d))	3-4
53	LMM	m d	Logical difference (m + (d))	3-4
54	STM	m d	Store (m + (d))	3-4
55	RAM	m d	Replace add (m + (d))	4-5
56	AOM	m d	Replace add one (m + (d))	4-5
57	SOM	m d	Replace subtract one (m + (d))	4-5
60	CRD	d	Central read from (A) to d	min. 6
61	CRM	m d	Central read (d) words from (A) to m	5 plus 5/word

F	MNE-MONIC	AD-DRESS	NAME	TIME (Major Cycles)
62	CWD	d	Central write to (A) from d	min. 6
63	CWM	m d	Central write (d) words to (A) from m	5 plus 5/word
64	AJM	m d	Jump to m if channel d active	2
65	IJM	m d	Jump to m if channel d inactive	2
66	FJM	m d	Jump to m if channel d full	2
67	EJM	m d	Jump to m if channel d empty	2
70	IAN	d	Input to A from channel d	2
71	IAM	m d	Input (A) words to m from channel d	4 plus 1/word
72	OAN	d	Output from A on channel d	2
73	OAM	m d	Output (A) words from m on channel d	4 plus 1/word
74	ACN	d	Activate channel d	2
75	DCN	d	Disconnect channel d	2
76	FAN	d	Function (A) on channel d	2
77	FNC	m d	Function m on channel d	2

2. ALPHABETICAL LISTING

MNE-MONIC	F	AD-DRESS-	NAME	TIME (Major Cycles)
ACN	74	d	Activate channel d	2
ADC	21	dm	Add dm	2
ADD	31	d	Add (d)	2
ADI	41	d	Add ((d))	3
ADM	51	m d	Add (m + (d))	3-4
ADN	16	d	Add d	1
AJM	64	m d	Jump to m if channel d active	2
AOD	36	d	Replace add one (d)	3
AOI	46	d	Replace add one ((d))	4
AOM	56	m d	Replace add one (m + (d))	4-5
CRD	60	d	Central read from (A) to d	min. 6
CRM	61	m d	Central read (d) words from (A) to m	5 plus 5/word
CWD	62	d	Central write to (A) from d	min. 6
CWM	63	m d	Central write (d) words to (A) from m	5 plus 5/word
DCN	75	d	Disconnect channel d	2
EJM	67	m d	Jump to m if channel d empty	2
EXN	260		Exchange jump*	
FAN	76	d	Function (A) on channel d	2
FJM	66	m d	Jump to m if channel d full	2
FNC	77	m d	Function m on channel d	2
IAM	71	m d	Input (A) words to m from channel d	4 plus 1/word
IAN	70	d	Input to A from channel d	2

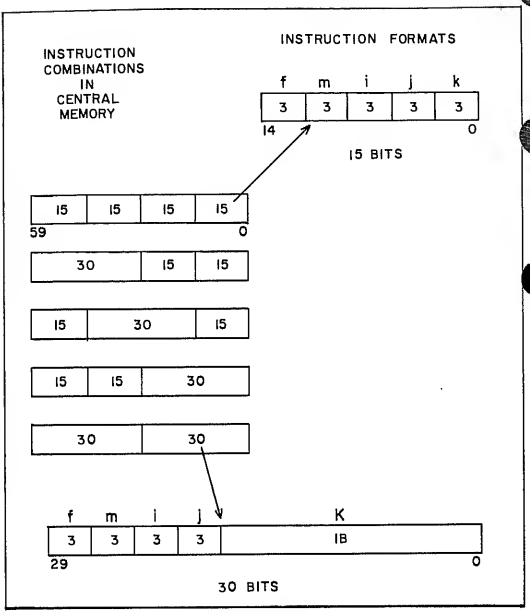
*In the 6500 System, Bit 0 specifies which CP the Exchange Jump will interrupt.

MNE-MONIC	F	AD-DRESS	NAME	TIME (Major Cycles)
IJM	65	m d	Jump to m if channel d inactive	2
LCN	15	d	Load complement d	1
LDC	20	m	Load dm	2
LDD	30	d	Load (d)	2
LDI	40	d	Load ((d))	3
LDM	50	m d	Load (m + (d))	3-4
LDN	14	d	Load d	1
LJM	01	m d	Long jump to m + (d)	2-3
LMC	23	dm	Logical difference dm	2
LMD	33	d	Logical difference (d)	2
LMI	43	d	Logical difference ((d))	3
LMM	53	m d	Logical difference (m+(d))	3-4
LMN	11	d	Logical difference d	1
LPC	22	dm	Logical product dm	2
LPN	12	d	Logical product d	1
MXN	261		Monitor exchange jump*	
MJN	07	d	Minus jump d	1
NJN	05	d	Nonzero jump d	1
OAM	73	m d	Output (A) words from m on channel d	4 plus 1/word
OAN	72	d	Output from A on channel d	2
PJN	06	d	Plus jump d	1
PSN	00		Pass	1
PSN	24		Pass	1
PSN	25		Pass	1

*Standard option 10103 for 6400, Standard option 10104 for 6600.

MNE-MONIC	F	AD-DRESS	NAME	TIME (Major Cycles)
RAD	35	d	Replace add (d)	3
RAI	45	d	Replace add ((d))	4
RAM	55	m d	Replace add (m + (d))	4-5
RJM	02	m d	Return jump to m + (d)	3-4
RPN	27		Read program address	1
SBD	32	d	Subtract (d)	2
SBI	42	d	Subtract ((d))	3
SBM	52	m d	Subtract (m+(d))	3-4
SBN	17	d	Subtract d	1
SCN	13	d	Selective clear d	1
SHN	10	d	Shift d	1
SOD	37	d	Replace subtract one (d)	3
SOI	47	d	Replace subtract one ((d))	4
SOM	57	m d	Replace subtract one (m + (d))	4-5
STD	34	d	Store (d)	2
STI	44	d	Store ((d))	3
STM	54	m d	Store (m + (d))	3-4
UJN	03	d	Unconditional jump d	1
ZJN	04	d	Zero jump d	1

EXPLANATION OF CENTRAL PROCESSOR INSTRUCTION FORMATS



EXPLANATION OF SYMBOLS USED IN CENTRAL PROCESSOR INSTRUCTION LISTINGS

A	One of eight address registers (18 bits)
B	One of eight index registers (18 bits) B0 is fixed and equal to zero
fm	Instruction code (6 bits)
i	Specifies which of eight designated registers (3 bits). Is also used in 03X instructions as part of a 9-bit operation code.
j	Specifies which of eight designated registers (3 bits)
jk	Constant, indicating number of shifts to be taken (6 bits)
k	Specifies which of eight designated registers (3 bits)
K	Constant, indicating branch destination or operand (18 bits)
X	One of eight operand registers (60 bits)

CENTRAL PROCESSOR INSTRUCTIONS

1. NUMERICAL LISTING

(Functional unit designation does not apply to 6400/6500).

BRANCH UNIT*

fm (i)	MNE-MONIC	AD-DRESS	NAME
00	PS		Program stop
010	RJ	K	Return jump to K
011	REC	Bj + K	Read extended core storage
012	WEC	Bj + K	Write extended core storage
013	XJ		Central exchange jump**
02	JP	Bi + K	Go to Bi + K
030	ZR	Xj K	Go to K if Xj = 0
031	NZ	Xj K	Go to K if Xj ≠ 0
032	PL	Xj K	Go to K if Xj = plus (positive)
033	NG	Xj K	Go to K if Xj = negative
034	IR	Xj K	Go to K if Xj is in range
035	OR	Xj K	Go to K if Xj is out of range
036	DF	Xj K	Go to K if Xj is definite
037	ID	Xj K	Go to K if Xj is indefinite
***04	EQ	BiBjK	Go to K if Bi = Bj
04	ZR	Bi K	Go to K if Bi = B0
05	NE	BiBjK	Go to K if Bi ≠ Bj
***05	NZ	Bi K	Go to K if Bi ≠ B0
06	GE	BiBjK	Go to K if Bi ≥ Bj
***06	PL	Bi K	Go to K if Bi ≥ B0
07	LT	BiBjK	Go to K if Bi < Bj
*07	NG	Bi K	Go to K if Bi < B0

*Go to K + Bi and Go To K if Bi - tests made in increment unit.
Go to K if Xj - tests made in long add unit.

**Standard Option 10103 for 6400. Standard Option 10104 for 6600. If option is not installed, this is an illegal instruction.

*For these instructions, ASCENT packs the instruction so Bi is compared with B0 rather than Bj.

BOOLEAN UNIT

fm (i)	MNE-MONIC	AD-DRESS	NAME
10	BXi	Xj	Transmit Xj to Xi
11	BXi	Xj*Xk	Logical Product of Xj & Xk to Xi
12	BXi	Xj+Xk	Logical sum of Xj & Xk to Xi
13	BXi	Xj-Xk	Logical difference of Xj & Xk to Xi
14	BXi	-Xk	Transmit the comp. of Xk to Xi
15	BXi	-Xk*Xj	Logical product of Xj & Xk comp. to Xi
16	BXi	-Xk+Xj	Logical sum of Xj & Xk comp. of Xi
17	BXi	-Xk-Xj	Logical difference of Xj & Xk comp. to Xi

SHIFT UNIT

20	LXi	jk	Left shift Xi, jk places
21	AXi	jk	Arithmetic right shift Xi, jk places
22	LXi	Bj Xk	Left shift Xk nominally Bj places to Xi
23	AXi	Bj Xk	Arithmetic right shift Xk nominally Bj places to Xi
24	NXi	Bj Xk	Normalize Xk in Xi and Bj
25	ZXi	Bj Xk	Round and normalize Xk in Xi and Bj
26	UXi	Bj Xk	Unpack Xk to Xi and Bj
27	PXi	Bj Xk	Pack Xi from Xk and Bj
43	MXi	jk	Form mask in Xi, jk bits

ADD UNIT

30	FXi	Xj+Xk	Floating sum of Xj and Xk to Xi
31	FXi	Xj-Xk	Floating difference Xj and Xk to Xi
32	DXi	Xj+Xk	Floating DP sum of Xj and Xk to Xi
33	DXi	Xj-Xk	Floating DP difference of Xj and Xk to Xi

ADD UNIT (Cont'd)

fm (i)	MNE-MONIC	AD-DRESS	NAME
34	RXi	Xj+Xk	Round floating sum of Xj and Xk to Xi
35	RXi	Xj - Xk	Round floating difference of Xj and Xk to Xi
36	IXi	Xj+Xk	Integer sum of Xj and Xk to Xi
37	IXi	Xj - Xk	Integer difference of Xj and Xk to Xi

MULTIPLY UNIT

40	FXi	Xj*Xk	Floating product of Xj and Xk to Xi
41	RXi	Xj*Xk	Round floating product of Xj & Xk to Xi
42	DXi	Xj*Xk	Floating DP product of Xj & Xk to Xi

DIVIDE UNIT

44	FXi	Xj / Xk	Floating divide Xj by Xk to Xi
45	RXi	Xj / Xk	Round floating divide Xj by Xk to Xi
46	NO		No operation
47	CXi	Xk	Count the number of 1's in Xk to Xi

INCREMENT UNIT

50	SAi	Aj+K	Set Ai to Aj + K
*50	SAi	Aj - K	Set Ai to Aj + comp. of K
51	SAi	Bj+K	Set Ai to Bj + K
*51	SAi	Bj - K	Set Ai to Bj + comp. of K
52	SAi	Xj+K	Set Ai to Xj + K
*52	SAi	Xj - K	Set Ai to Xj + comp. of K

*If the sign in the address field is minus, ASCENT complements the 18-bit quantity K.

INCREMENT UNIT (Cont'd)

fm (i)	MNE-MONIC	AD-DRESS	NAME
53	SAi	Xj+Bk	Set Ai to Xj + Bk
54	SAi	Aj+Bk	Set Ai to Aj + Bk
55	SAi	Aj - Bk	Set Ai to Aj - Bk
56	SAi	Bj+Bk	Set Ai to Bj + Bk
57	SAi	Bj - Bk	Set Ai to Bj - Bk
60	SBi	Aj+K	Set Bi to Aj + K
*60	SBi	Aj - K	Set Bi to Aj + comp. of K
61	SBi	Bj+K	Set Bi to Bj + K
*61	SBi	Bj - K	Set Bi to Bj + comp. of K
62	SBi	Xj+K	Set Bi to Xj + K
*62	SBi	Xj - K	Set Bi to Xj + comp. of K
63	SBi	Xj+Bk	Set Bi to Xj + Bk
64	SBi	Aj+Bk	Set Bi to Aj + Bk
65	SBi	Aj - Bk	Set Bi to Aj - Bk
66	SBi	Bj+Bk	Set Bi to Bj + Bk
67	SBi	Bj - Bk	Set Bi to Bj - Bk
70	SXi	Aj+K	Set Xi to Aj + K
*70	SXi	Aj - K	Set Xi to Aj + comp. of K
71	SXi	Bj+K	Set Xi to Bj + K
*71	SXi	Bj - K	Set Xi to Bj + comp. of K
72	SXi	Xj+K	Set Xi to Xj + K
*72	SXi	Xj - K	Set Xi to Xj + comp. of K
73	SXi	Xj+Bk	Set Xi to Xj + Bk
74	SXi	Aj+Bk	Set Xi to Aj + Bk
75	SXi	Aj - Bk	Set Xi to Aj - Bk
76	SXi	Bj+Bk	Set Xi to Bj + Bk
77	SXi	Bj - Bk	Set Xi to Bj - Bk

*If the sign in the address field is minus, ASCENT complements the 18-bit quantity K.

2. ALPHABETICAL LISTING

MNE-MONIC	fm (i)	AD-DRESS	NAME
AXi	21	jk	Arithmetic right shift Xi, jk places
AXi	23	Bj Xk	Arithmetic right shift Xk nominally Bj places to Xi
BXi	10	Xj	Transmit Xj to Xi
BXi	11	Xj*Xk	Logical product of Xj & Xk to Xi
BXi	12	Xj+Xk	Logical sum of Xj & Xk to Xi
BXi	13	Xj-Xk	Logical difference of Xj & Xk to Xi
BXi	14	-Xk	Transmit the comp. of Xk to Xi
BXi	15	-Xk*Xj	Logical product of Xj & Xk comp. to Xi
BXi	16	-Xk+Xj	Logical sum of Xj & Xk comp. to Xi
BXi	17	-Xk-Xj	Logical difference of Xj & Xk comp. to Xi
CXi	47	Xk	Count the number of 1's in Xk to Xi
DF	036	Xj K	Go to K if Xj is definite
DXi	32	Xj+Xk	Floating DP sum of Xj and Xk to Xi
DXi	33	Xj-Xk	Floating DP difference of Xj and Xk to Xi
DXi	42	Xj*Xk	Floating DP product of Xj & Xk to Xi
EQ	04	Bi Bj K	Go to K if Bi = Bj
FXi	30	Xj+Xk	Floating sum of Xj and Xk to Xi
FXi	31	Xj-Xk	Floating difference Xj and Xk to Xi
FXi	40	Xj*Xk	Floating product of Xj and Xk to Xi
FXi	44	Xj/Xk	Floating divide Xj by Xk to Xi
GE	06	Bi Bj K	Go to K if Bi $\geq$ Bj

MNE-MONIC	fm (i)	AD-DRESS	NAME
ID	037	Xj K	Go to K if Xj if indefinite
IR	034	Xj K	Go to K if Xj is in range
IXi	36	Xj+Xk	Integer sum of Xj and Xk to Xi
IXi	37	Xj-Xk	Integer difference of Xj and Xk to Xi
JP	02	Bi+Bk	Go to Bi + K
LT	07	BiBjK	Go to K if Bi < Bj
LXi	20	jk	Left shift Xi, jk places
LXi	22	Bj Xk	Left shift Xk nominally Bj places to Xi
XJ	013		Central exchange jump*
MXi	43	jk	Form mask in Xi, jk bits
NE	05	BiBjK	Go to K if Bi ≠ Bj
NG	033	Xj K	Go to K if Xj = negative
NG	**07	Bi K	Go to K if Bi < B0
NO	46		No operation
NXi	24	Bi Xk	Normalize Xk in Xi and Bj
NZ	031	Xj K	Go to K if Xj ≠ 0
NZ	**05	Bi K	Go to K if Bi ≠ B0
OR	035	Xj K	Go to K if Xj is out of range
PL	032	Xj K	Go to K if Xj = plus (positive)
PL	06	Bi K	Go to K if Bi ≧ B0
PS	00		Program stop
PXi	27	Bj Xk	Pack Xi from Xk and Bj
REC	011	Bj+K	Read extended core storage
RJ	01	K	Return jump to K
RXi	34	Xj+Xk	Round floating sum of Xj and Xk to Xi
RXi	35	Xj-Xk	Round floating difference of Xj and Xk to Xi
RXi	41	Xj*Xk	Round floating product of Xj & Xk to Xi
RXi	45	Xj/Xk	Round floating divide Xj by Xk to Xi

*Standard Option 10103 for 6400. Standard Option 10104 for 6600. If option is not installed, this is an illegal instruction.

**If the sign in the address field is minus, ASCENT complements the 18-bit quantity K.

MNE-MONIC	fm (i)	AD-DRESS	NAME
SAi	50	Aj+K	Set Ai to Aj + K
SAi	*50	Aj-K	Set Ai to Aj + comp. of K
SAi	51	Bj+K	Set Ai to Bj + K
SAi	*51	Bj-K	Set Ai to Bj + comp. of K
SAi	52	Xj+K	Set Ai to Xj + K
SAi	*52	Xj-K	Set Ai to Xj + comp. of K
SAi	53	Xj+Bk	Set Ai to Xj + Bk
SAi	54	Aj+Bk	Set Ai to Aj + Bk
SAi	55	Aj-Bk	Set Ai to Aj - Bk
SAi	56	Bj+Bk	Set Ai to Bj + Bk
SAi	57	Bj-Bk	Set Ai to Bj - Bk
SBi	60	Aj+K	Set Bi to Aj + K
SBi	*60	Aj-K	Set Bi to Aj + comp. of K
SBi	61	Bj+K	Set Bi to Bj + K
SBi	*61	Bj-K	Set Bi to Bj + comp. of K
SBi	62	Xj+K	Set Bi to Xj + K
SBi	*62	Xj-K	Set Bi to Xj + comp. of K
SBi	63	Xj+Bk	Set Bi to Xj + Bk
SBi	64	Aj+Bk	Set Bi to Aj + Bk
SBi	65	Aj-Bk	Set Bi to Aj - Bk
SBi	66	Bj+Bk	Set Bi to Bj + Bk
SBi	67	Bj-Bk	Set Bi to Bj - Bk
SXi	70	Aj+K	Set Xi to Aj + K
SXi	*70	Aj-K	Set Xi to Aj + comp. of K
SXi	71	Bj+K	Set Xi to Bj + K
SXi	*71	Bj-K	Set Xi to Bj + comp. of K
SXi	72	Xj+K	Set Xi to Xk + K
SXi	*72	Xj-K	Set Xi to Xj + comp. of K
SXi	73	Xj+Bk	Set Xi to Xj + Bk
SXi	74	Aj+Bk	Set Xi to Aj + Bk
SXi	75	Aj-Bk	Set Xi to Aj - Bk
SXi	76	Bj+Bk	Set Xi to Bj + Bk
SXi	77	Bj-Bk	Set Xi to Bj - Bk

*If the sign in the address field is minus, ASCENT complements the 18-bit quantity K.

MNE-MONIC	fm (i)	AD-DRESS	NAME
UXi	26	Bj Xk	Unpack Xk to Xi and Bj
WEC	012	Bj+K	Write extended core storage
ZR	030	Xj K	Go to K if Xj = 0
ZR	*04	Bi K	Go to K if Bi = B0
ZXi	25	Bj Xk	Round and normalize Xk in Xi and Bj

3. EXIT MODES

EM = 000000 Stop

= 010000 Address out of range - an attempt to reference memory outside established limits

= 020000 Operand out of range - floating point arithmetic generated or regenerated an infinite result

= 030000 Address or operand out of range

= 040000 Indefinite operand - floating point arithmetic generated or regenerated an indefinite result

= 050000 Indefinite operand or address out of range

= 060000 Indefinite operand or operand out of range

= 070000 Address or operand out of range, or indefinite operand

EM = Bits 48, 49, 50 of location n + 3 of Exchange Jump package. Other bits of EM word are irrelevant.

*For these instructions, ASCENT packs the instruction so Bi is compared with B0 rather than Bj.

4. INSTRUCTION EXECUTION TIMES

All times are given in minor cycles:
One minor cycle = 100 nanoseconds

OCTAL CODE		6400/ 6500	6600
00	Stop	-	-
01	Return Jump to K	21	13
011	Read Extended Core Storage	††	††
012	Write Extended Core Storage	††	††
02	Go to K + Bi	†††13	14
030	Go to K if Xj = zero	†††13	9†
031	Go to K if Xj ≠ zero	†††13	9†
032	Go to K if Xj = positive	†††13	9†
033	Go to K if Xj = negative	†††13	9†
034	Go to K if Xj is in range	†††13	9†
035	Go to K if Xj is out of range	†††13	9†
036	Go to K if Xj is definite	†††13	9†
037	Go to K if Xj is indefinite	†††13	9†
04	Go to K if Bi = Bj	†††13	8†
05	Go to K if Bi = Bj	†††13	8†
06	Go to K if Bi ≥ Bj	†††13	8†
07	Go to K if Bi < Bj	†††13	8†
10	Transmit Xj to Xi	5	3
11	Logical Product of Xj and Xk to Xi	5	3
12	Logical Sum of Xj and Xk to Xi	5	3
13	Logical Difference of Xj and Xk to Xi	5	3
14	Transmit Xk comp. to Xi	5	3
15	Logical Product of Xj and Xk comp. to Xi	5	3
16	Logical Sum of Xj and Xk comp. to Xi	5	3
17	Logical Difference of Xj and Xk comp. to Xi	5	3

†Modify the execution time (T) according to this table.

	Branch	No Branch
Loop (in stack)	T	T+2
Jump (out of stack)	T+6	T+5

††See ECS literature for timing information.

†††No branch condition requires 5 minor cycles.

OCTAL CODE		6400/ 6500	6600
20	Shift Xi Left jk places	6	3
21	Shift Xi Right jk places	6	3
22	Shift Xk Nominally Left Bj places to Xi	6	3
23	Shift Xk Nominally Right Bj places to Xi	6	3
24	Normalize Xk in Xi and Bj	7	4
25	Round and Normalize Xk in Xi and Bj	7	4
26	Unpack Xk to Xi and Bj	7	3
27	Pack Xi from Xk and Bj	7	3
43	Form jk Mask in Xi	6	3
30	Floating Sum of Xj and Xk to Xi	11	4
31	Floating Difference of Xj and Xk to Xi	11	4
32	Floating DP Sum of Xj and Xk to Xi	11	4
33	Floating DP Difference of Xj and Xk to Xi	11	4
34	Round Floating Sum of Xj and Xk to Xi	11	4
35	Round Floating Difference of Xj and Xk to Xi	11	4
36	Integer Sum of Xj and Xk to Xi	6	3
37	Integer Difference of Xj and Xk to Xi	6	3
40	Floating Product of Xj and Xk to Xi	57	10
41	Round Floating Product of Xj and Xk to Xi	59	10
42	Floating DP Product of Xj and Xk to Xi	57	10
44	Floating Divide Xj by Xk to Xi	56	29
45	Round Floating Divide Xj by Xk to Xi	57	29
46	Pass	3	1
47	Sum of 1's in Xk to Xi	68	8
50	Sum of Aj and K to Ai	†	3
51	Sum of Bj and K to Ai	†	3
52	Sum of Xj and K to Ai	†	3
53	Sum of Xj and Bk to Ai	†	3
54	Sum of Aj and Bk to Ai	†	3
55	Difference of Aj and Bk to Ai	†	3
56	Sum of Bj and Bk to Ai	†	3
57	Difference of Bj and Bk to Ai	†	3
60	Sum of Aj and K to Bi	5	3
61	Sum of Bj and K to Bi	5	3
62	Sum of Xj and K to Bi	5	3

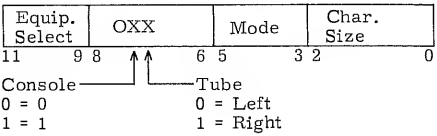
†When i = 0; time = 6 minor cycles
i = 1-5; time = 12 minor cycles
i = 6-7; time = 10 minor cycles

OCTAL CODE		6400/ 6500	6600
63	Sum of Xj and Bk to Bi	5	3
64	Sum of Aj and Bk to Bi	5	3
65	Difference of Aj and Bk to Bi	5	3
66	Sum of Bj and Bk to Bi	5	3
67	Difference of Bj and Bk to Bi	5	3
70	Sum of Aj and K to Xi	6	3
71	Sum of Bj and K to Xi	6	3
72	Sum of Xj and K to Xi	6	3
73	Sum of Xj and Bk to Xi	6	3
74	Sum of Aj and Bk to Xi	6	3
75	Difference of Aj and Bk to Xi	6	3
76	Sum of Bj and Bk to Xi	6	3
77	Difference of Bj and Bk to Xi	6	3

EXTERNAL FUNCTION CODES AND STATUS RESPONSES

1. 6602/6612 CONSOLE DISPLAY

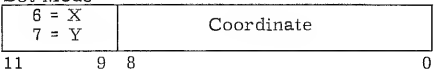
Function Word



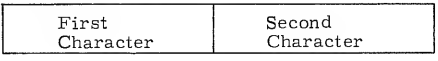
Console 0	Console 1	
7000	7200	Select 64 Char./Line, Left Screen
7001	7201	Select 32 Char./Line, Left Screen
7002	7202	Select 16 Char./Line, Left Screen
7010	7210	Select 512 Dots/Line
7020	7220	Select Keyboard Input
7100	7300	Select 64 Char./Line, Right Screen
7101	7301	Select 32 Char./Line, Right Screen
7102	7302	Select 16 Char./Line, Right Screen

Data Word

Dot Mode

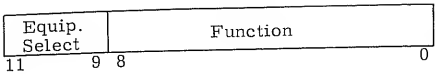


Character Mode



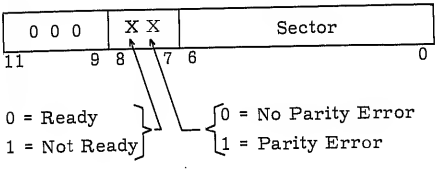
2. 6603 DISK SYSTEM

Function Word

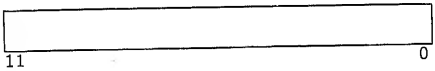


10XX	Read Sector XX (sectors 00-77)
11XX	Read Sector XX (sectors 100-177)
12XX	Write Sector XX (sectors 00-77)
13XX	Write Sector XX (sectors 100-177)
14XX	Select Track XX (tracks 00-77)
15XX	Select Track XX (tracks 100-177)
16YX*	Select Head Group X
1700	Status Request

Status Reply Word



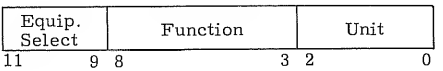
Data Word



*Y is a function of the read sample time. Normal sampling occurs when Y = 0.

3. 6622 MAGNETIC TAPE CONTROLLER (626-B MAGNETIC TAPE UNIT)

Function Word

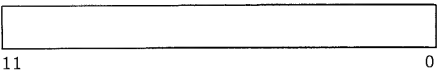


300X	Select
301X	Write Binary
302X	Read Binary
303X	Backspace
306X	Rewind
307X	Rewind Unload
3100	Status Request
361X	Write File Mark

(X = Unit = 0-7)

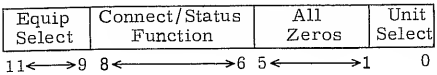
Status Reply:
- 0000 = Ready
- 0001 = Not Ready
- 0002 = Parity Error
- 0004 = Load Point
- 0010 = End of Tape
- 0020 = File Mark
- 0040 = Write Lockout

Data Word



4. 6638 DISK SYSTEM (6639 DISK FILE CONTROLLER)

Connect and Status Function Code



17X0 Connect and Request Status Word 1 for Unit 0

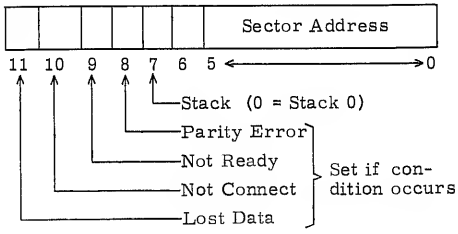
17X1 Connect and Request Status Word 1 for Unit 1

15X0 Connect and Request Status Word 2 for Unit 0

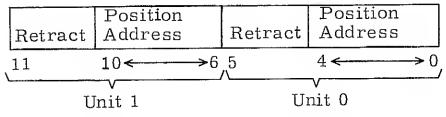
15X1 Connect and Request Status Word 2 for Unit 1

Note: Bit 0 is not used if Standard Option 10037 is installed.

Status Word 1

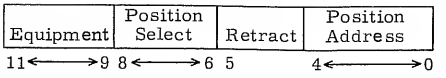


Status Word 2



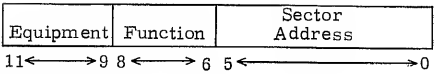
Note: Unit 1 is all zeros if Standard Option 10037 is installed.

Position Select Function Code



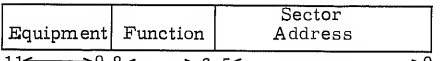
14 1xx X Position Select and Retract Heads*
14 0xx X Position Select and do not Retract Heads.*

Head Group Select Function Code



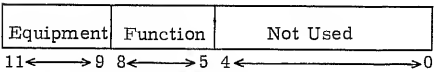
16 XX Head Group Select Function Code

Read/Write Function Code



1 01x XX Write Function Code*
1 00x XX Read Function Code*

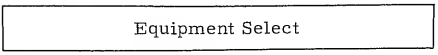
Disconnect Function Code



1 1x1 1xx X Disconnect Function Code*

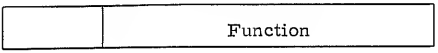
*Small digits are binary numbers; large digits are octal numbers.

5. 6681 DATA CHANNEL CONVERTER (3000 SERIES INTERFACE)



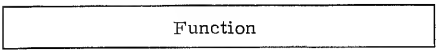
2000	Select
2100	Deselect

Mode I Function Word



Connect:	4XXX	Connect External Equipment 4
	5XXX	Connect External Equipment 5
	6XXX	Connect External Equipment 6
	7XXX	Connect External Equipment 7
Function:	0XXX	Send 9-bit Function Code to External Equipment Connected

Mode II Function Word



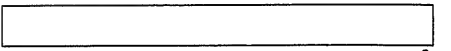
Connect:	1000	Select 6681 to Output a 12-bit Connect Code
Function:	1100	Select 6681 to Output a 12-bit Function Code to External Equipment Connected

Status:	1200	6681 Status Request
	1300	External Equipment Status Request
Status Reply:	XXX1	Reject (internal or external)
	XXX2	Internal Reject
	XXX4	Transmission Parity Error
XX1X -	2XXX	Eight Interrupt Lines
Data I/O:	1400	Input to End of Record
	1500	Input until computer sends Inactive signal
	1600	Output until computer sends Inactive signal

A "1" in the lowest bit of Data I/O codes negates BCD conversion. The BCD negated is normal mode of operation.

1700	Master Clear

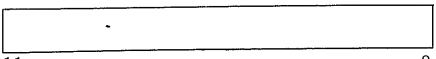
Data Word



NOTE: For 3000 Series peripheral equipment codes, refer to Pub. No. 60113400.

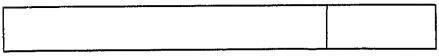
6. 6682/6683 SATELLITE COUPLER

Equipment Select



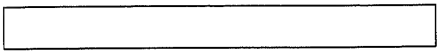
*S000	Output
S100	Input
S200	Status Request

Status



XXX1	Output Channel Request
XXX2	Input Channel Request
XXX4	Busy

Data Word



*S is determined by machine installation.

7. 6411/6416 AUGMENTED I/O BUFFER AND CONTROL

All instructions are the same as 6600 Peripheral Processors except:

26	ECT	d	Extended Core Transfer; initiate Extended Core Storage operation
27	RCS	d	Read Extended Core Coupler status

Status Reply: (Read into upper 3 bits of Peripheral Processor A Register)

Bit 17 Extended Core Storage Transfer in progress

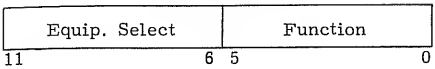
Bit 16 Parity error occurred during last Read Extended Core Storage operation

Bit 15 At least one address of the last Extended Core Storage Transfer was not available (Power off, in Maintenance mode, address not in system).

8. 1612 PRINTER

(Special Option 60022)

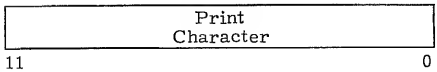
Function Word



0600	Select Printer
0601	Single Space
0602	Double Space
0603	Move Paper to Format Channel 7
0604	Move Paper to Top of Form
0605	Print
0606	Suppress Line Advance After Next Print
0607	Status Request
0610	Clear Format Channels
061X	Select Format Channel X (X = 1-6)

Status Reply:	0000	Not Ready
	4000	Ready

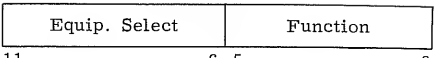
Data Word



9. 170 CARD PUNCH

(Special Option 60022)

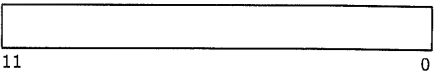
Function Word



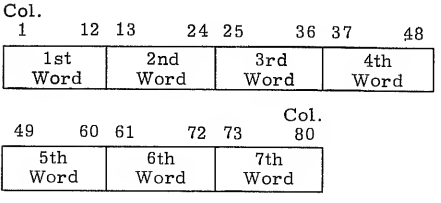
3000	Deselect
3002	Select Punch
3040	Status Request

Status Reply: 0000 = Ready
0200 = Manual Switch in 1604 Position
2000 = Not Ready

Data Word



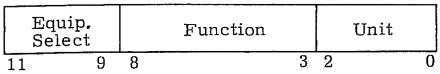
Word Assembly Sequence



10. 607-B MAGNETIC TAPE UNIT

(Special Option 60028)

Function Word



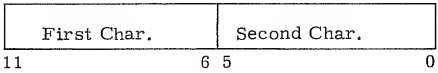
200X	Select
201X	Write Binary
202X	Read Binary
203X	Backspace
206X	Rewind
207X	Rewind Unload
2100	Status Request
221X	Write BCD
222X	Read BCD
261X	Write File Mark

(X = unit = 0-7)

Status Reply: 0X00 = Ready
0X01 = Not Ready
0X02 = Parity Error
0X04 = Load Point
0X10 = End of Tape
0X20 = File Mark
0X40 = Write Lockout

X = 0: 800 bpi
X = 1: 556 bpi
X = 2: 200 bpi

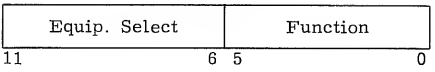
Data Word



11. 405-B CARD READER

(Special Option 60029)

Function Word

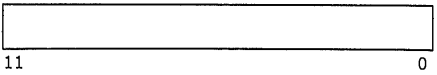


0700	Deselect
0701	Gate Card to Secondary Bin
0702	Read Non-Stop
0704	Status Request

Status Reply: 0000 = Ready
0001 = Not Ready
0002 = End of File
0004 = Compare Error

To read one card, execute successive S702 and S704 functions.

Data Word



CONSOLE DISPLAY CODES

CHAR.	CODE	CHAR.	CODE
(space)	00	X	30
A	01	Y	31
B	02	Z	32
C	03	0	33
D	04	1	34
E	05	2	35
F	06	3	36
G	07	4	37
H	10	5	40
I	11	6	41
J	12	7	42
K	13	8	43
L	14	9	44
M	15	+	45
N	16	-	46
O	17	*	47
P	20	/	50
Q	21	(	51
R	22	)	52
S	23	blank	53
T	24	=	54
U	25	blank	55
V	26	,	56
W	27	.	57

Keyboard codes are identical with the following exceptions:

No Data	00
Carriage Return	60
Backspace	61
Space	62

PRINTER CODES (EXT. BCD)

CHAR.	CODE	CHAR.	CODE
(blank)	20	V	25
0	12	W	26
1	01	X	27
2	02	Y	30
3	03	Z	31
4	04	.	73
5	05	- (minus)	40
6	06	+	60
7	07	=	13
8	10	(	34
9	11	)	74
A	61	*	54
B	62	,	33
C	63	:	00
D	64	≠	14
E	65	/	21
F	66	≦	15
G	67	%	16
H	70	⊏	17
I	71	⊐	32
J	41	→	35
K	42	≡	36
L	43	∧ (and)	37
M	44	∨ (or)	52
N	45	$	53
O	46	↑	55
P	47	↓	56
Q	50	>	57
R	51	<	72
S	22	≧	75
T	23	¬ (not)	76
U	24	;	77

HOLLERITH PUNCH CARD CODES

CHAR.	CODE	CHAR.	CODE
A	12-1	Y	0-8
B	12-2	Z	0-9
C	12-3	0	0
D	12-4	1	1
E	12-5	2	2
F	12-6	3	3
G	12-7	4	4
H	12-8	5	5
I	12-9	6	6
J	11-1	7	7
K	11-2	8	8
L	11-3	9	9
M	11-4	/	0-1
N	11-5	+	12
O	11-6	- (dash)	11
P	11-7	blank	space
Q	11-8	.	12-8-3
R	11-9	)	12-8-4
S	0-2	$	11-8-3
T	0-3	*	11-8-4
U	0-4	,	0-8-3
V	0-5	(	0-8-4
W	0-6	=	8-3
X	0-7	_	8-4

CONTROL DATA
CORPORATION

8100 34th AVENUE SOUTH, MINNEAPOLIS 20, MINNESOTA